GOVERNMENT OF PUNJAB

DEPARTMENT OF WATER RESOURCES

NOTIFICATION

The 21st April, 2025

No.17/10/2024-3IP3/161.-

1.0   In the Department of Water Resources the procedure for recognizing the importance of accurate discharge measurement, the Government consituted a committee to provide recommendation regarding guidelines of calculation of discharge for Canals and vide order no 5114-47/PSWR/Canals dated: 22-08-2024, guidelines have been formulated and attached as Annexure-1. These guidelines have been adopted by the Department after approval from the competent authority.

Sd/-

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Principal Secretary Water Resources.

Committee report regarding calculation of discharge for canals vide order 2854-59/PSWR dated 26.04.2024

Frequent discharge measurement in canals is crucial for the proper regulation of the canal system. Recognizing the importance of accurate discharge measurements, the government, via an order dated April 26, 2024, constituted a committee to provide recommendations for discharge measurement in running canal systems. Keeping in view that discharge measurement depends upon the canals cross-section area, committee deliberate the following points:-

1.0 Canals (Lined/Unlined) with a Width Greater than 5 Feet:

a. **Acoustic Doppler Current Profiler (ADCP) for Canal Discharge Measurement:**

i. **Overview:**

The Acoustic Doppler Current Profiler (ADCP) is a sophisticated instrument used for measuring water current velocities and discharge in open channels, such as canals. Utilizing the Doppler effect, ADCPs provide detailed and accurate measurements of water flow, making them invaluable tools for hydrological studies, canal management, and environmental monitoring.

ii. **Working Principle:**

(a) <u>Sound Wave Emission:</u>

The ADCP emits sound waves into the water at a known frequency. These sound waves travel through the water column until they encounter moving particles, such as sediment or small organisms.

(b) <u>Doppler Shift Detection:</u>

When the emitted sound waves hit these particles, they are reflected back to the ADCP. The moving particles cause a change in the frequency of the reflected sound waves, known as the Doppler shift.

(c) <u>Velocity Calculation:</u>

The ADCP analyzes the frequency shift to determine the velocity of the water at various depths. By measuring the time it takes for the sound waves to return, the instrument can also determine the distance to the particles, providing a vertical profile of water velocities.

(d) <u>Discharge Calculation:</u>

The ADCP divides the water column into several vertical layers, or bins, and measures the velocity in each bin. By integrating these velocity measurements across the cross-sectional area of the canal, the total discharge can be calculated.

(e) <u>Advantages of ADCP:</u>

High Accuracy: ADCPs provide precise measurements of water velocity and discharge

(f) Detailed Profiles:
The instrument offers a comprehensive vertical profile of water velocities.

(g) Non-Intrusive:
ADCPs can be deployed without disrupting the flow or structure of the canal.

(h) Versatility:
Suitable for various water bodies, including rivers, streams, and canals

(i) Limitations:
Width and Depth Constraints: ADCPs are less effective in narrow canals where the width is less than 5 feet and in very shallow depths.

iii. Application in Canal Discharge Measurement:

For canals with widths greater than 5 feet and adequate depth, ADCPs are the preferred method for discharge measurement. They are particularly useful in environments where traditional flow measurement methods, like weirs or flumes, are impractical due to the dynamic nature of the flow or the physical constraints of the site.

iv. Example of ADCP Measurement Process:
(a) Setup: The ADCP is mounted on a boat, bridge, or a stationary platform within the canal.
(b) Data Collection: The instrument emits sound pulses and records the returned signals.
(c) Data Processing: The collected data is processed to determine the velocity profile and calculate the discharge.
(d) Calibration: The system may be calibrated using known flow rates to ensure accuracy.

v. Conclusion:-

The ADCP is a powerful tool for measuring discharge in large canals, providing detailed and accurate flow data critical for effective canal system management and regulation. Despite its limitations in narrower or shallower channels, its non-intrusive nature and high precision make it an essential instrument in hydrological studies.

2.0 Distributaries/Minors (Lined) with a Width Less than 5 Feet
i. **Permanent gauges** should be installed by painting marks on the channel sides.
ii. The canal's discharge can be calculated using the cross-sectional area and other parameters as per the longitudinal section (L-section), with the gauge calibrated accordingly.
iii. These gauges should be installed approximately 500 feet downstream of the offtaking structure where the canal flow is non-turbulent.

3.0 Distributaries/Minors (Unlined) with a Width Less than 5 Feet
i. **Parshall flume structures** are to be installed.
ii. Overview of Parshall Flume Functionality:

a. Description & Dimensions-

(a) Parshall flume is a measuring flume having a converging entrance section with a level floor, a short throat section.

(b) A floor inclined downwards at a gradient of 3:8,

(c) A diverging exit section with a floor inclined upwards at a gradient of 1:6. **(Figure.1).**

(d) The floor of the entrance section shall be truly level both longitudinally and laterally.

(e) The side walls shall be vertical and disposed at a constant angle of convergence of 11" 19' or shall have a 1:5 contraction in plan with respect to the flume axis.

(f) The side walls of the throat shall be parallel in plan.

(g) The line of intersection of the entrance section floor with the throat floor is known as the crest of the flume.

(h) The side walls of the exit section shall be vertical and disposed at a constant angle of divergence of 9" 28' or shall have a 1:6 expansion in plan with respect to the flume axis.

(i) To ensure a smooth entry of the flow into the flume and to prevent surface disturbance at the exit of the flume, the entrance and exit cross-sections shall be connected to the natural channel banks or the artificial channel side slopes by means of vertical wing walls disposed at 45" to the flume axis or curved in plan with a radius $R \geq 2h$.

(j) **Variations:** Available in different sizes Parshall flumes accommodate various flow ranges, with standardized charts and equations for converting water depth measurements into flow rates.(*As a general rule, the width of the Parshall flume should be about one-third to one-half the width of the upstream canal water surface at design discharge and normal depth)*
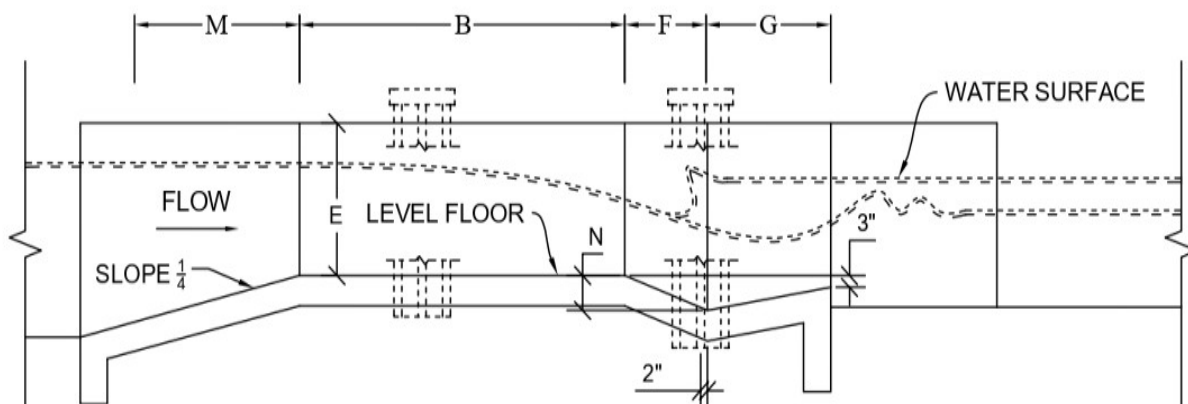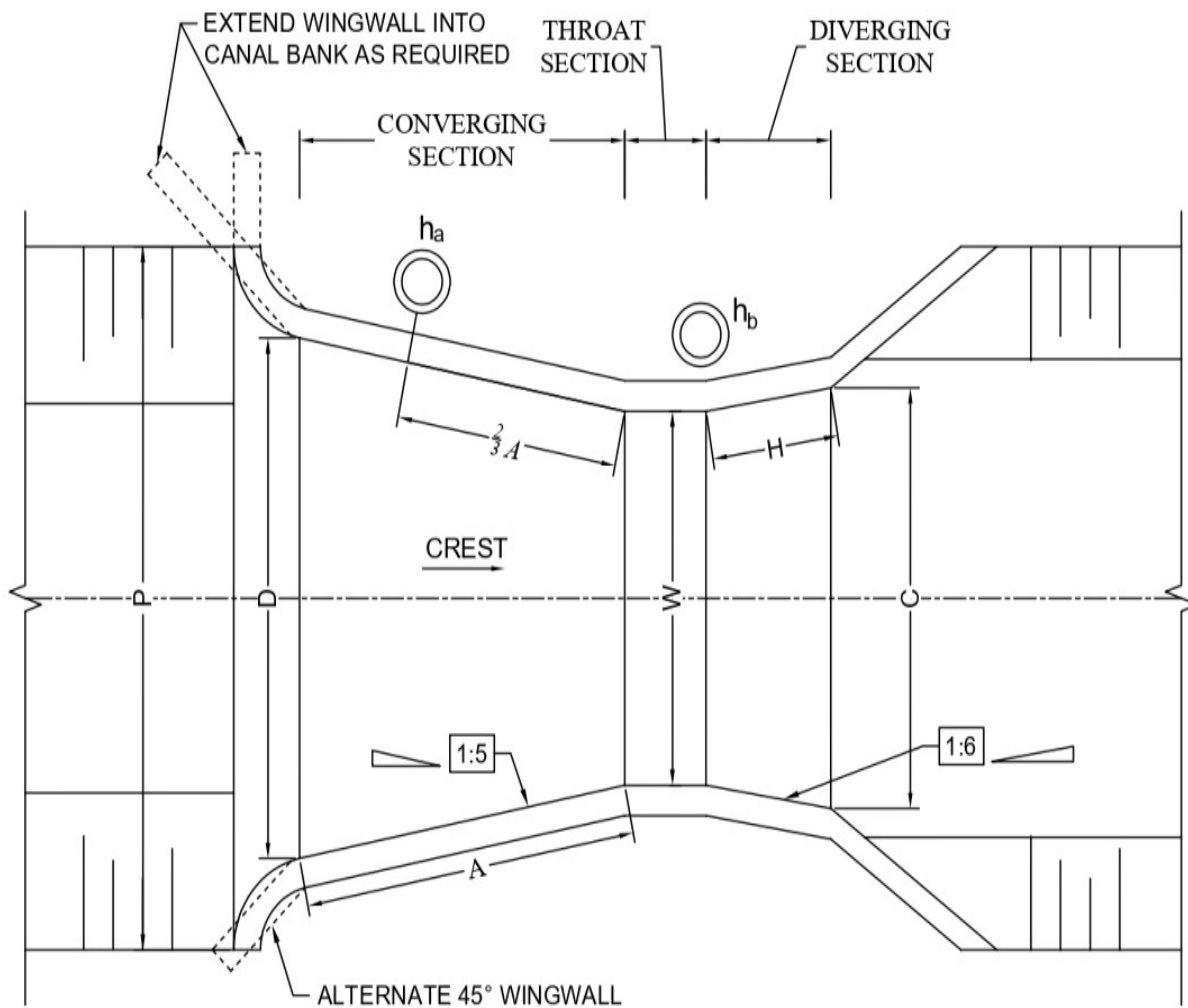
FIGURE-1

REFER TABLE -1 FOR DIMNESIONS

Table 1- Standard Parshall Flume Dimensions

W		A		2/3A		B		C		D		E		F		G		M		N		P		R		FREE FLOW CAPACITY	
FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	FT.	IN.	MINIMUM C.F.S	MAXIMUM C.F.S
0	6	2	7/16	1	4+5/16	2	0	1	3+1/2	1	3+5/8	2	0	1	0	2	0	1	0	0	4.5	2	11.5	1	4	0.05	3.9
0	9	2	10+5/8	1	11+1/8	2	10	1	3	1	10+5/8	2	6	1	0	1	6	1	0	0	4.5	3	6.5	1	4	0.09	8.9
1	0	4	6	3	0	4	4+7/8	2	0	2	9.25	3	0	2	0	3	0	1	3	0	9	4	10.75	1	8	0.11	16.1
1	6	4	9	3	2	4	7+7/8	2	6	3	4+3/8	3	0	2	0	3	0	1	3	0	9	5	6	1	8	0.15	24.6
2	0	5	0	3	4	4	10+7/8	3	0	3	11.5	3	0	2	0	3	0	1	3	0	9	6	1	1	8	0.42	33.1
3	0	5	6	3	8	5	4.75	4	0	5	1+7/8	3	0	2	0	3	0	1	3	0	9	7	3.5	1	8	0.61	50.4
4	0	6	0	4	0	5	10+5/8	5	0	6	4.25	3	0	2	0	3	0	1	6	0	9	8	10.75	2	0	1.30	67.9
5	0	6	6	4	4	6	4.5	6	0	7	6+5/8	3	0	2	0	3	0	1	6	0	9	10	1.25	2	0	1.60	85.6
6	0	7	0	4	8	6	10+3/8	7	0	8	9	3	0	2	0	3	0	1	6	0	9	11	3.5	2	0	2.60	103.5
7	0	7	6	5	0	7	4.25	8	0	9	11+3/8	3	0	2	0	3	0	1	6	0	9	12	6	2	0	3.00	121.4
8	0	8	0	5	4	7	10+1/8	9	0	11	1.75	3	0	2	0	3	0	1	6	0	9	13	8.25	2	0	3.50	139.5

a) Data Required:-

Parshall flume sizes are designated by their throat widths. Before a Parshall flume can be selected, the channel cross section, the range of discharges to be measured, allowable head loss/ available fall through the flume and the normal depth of the flow in the channel must be known.

Installation Procedure for Parshall Flume in Unlined Canal Sections

1. Site Selection and Preparation

1.1. Select the Location: Identify a section of the canal with uniform flow, away from bends, obstructions, or turbulence.

1.2. Clear the Area: Remove debris, vegetation, and loose soil from the selected site.

1.3. Level the Site: Ensure the base is level and firm to support the flume.

2. Design and Measurement

2.1. Determine the Flume Size: Select a Parshall flume size appropriate for the expected flow range.

2.2. Mark the Position: Measure and mark the exact location for flume installation.

The discharge through Parshall flume operating under free-flow conditions (that is, h_b/h_a ratio < 60%) is obtained from the following general equation:

- For 6 inch:-

$$Q = 2.06 * Ha^{1.58}$$

- For 9 inch:-

$$Q = 3.07 * Ha^{1.53}$$

- From 1 feet to 5 feet:-

$$Q = 4W * Ha^{1.522 * w^{0.026}}$$

where,

Q = the discharge, in cubic feet per second

W = the throat width, in feet

ha = the head in entrance section, in feet

3. Excavation

3.1. Dig the Trench: Excavate a trench across the canal to accommodate the flume, ensuring it is wide enough for easy installation and maintenance.

3.2. Ensure Proper Depth: Match the trench depth with the flume's specifications, ensuring it sits level with the canal bed.

4. Flume Installation

4.1. Place the Flume: Carefully lower the flume into the trench, ensuring it is level and aligned with the flow direction.

4.2. Check Alignment: Use a level to verify the flume's horizontal and vertical alignment.

5. Backfilling and Anchoring

5.1. Backfill around the Flume: Fill the trench with soil or gravel around the flume, compacting it to provide stability and prevent shifting.

5.2. Secure the Flume: Use anchors or stakes if necessary to secure the flume, particularly in areas prone to erosion or high flow.

6. Transition and Approach Sections

6.1. Construct Transition Sections: Build smooth transition sections upstream and downstream to guide the flow into and out of the flume.

6.2. Ensure Smooth Flow: Ensure the approach section is straight and smooth for a distance of at least 10 times the width of the flume throat.

7. Calibration and Testing

7.1. Calibrate the Flume: Use known flow rates to calibrate the flume and ensure accurate measurements.

7.2. Test the Installation: Conduct several test runs to check for leaks, proper flow, and accurate readings.

8. Maintenance and Monitoring

8.1. Regular Inspection: Periodically inspect the flume for signs of wear, damage, or blockage.

8.2. Clear Debris: Remove any debris or sediment buildup that might affect flow and measurement accuracy.

Tools and Materials Needed

- Parshall flume
- Measuring tape

- Shovels and excavation tools

- Level

- Backfill material (soil, gravel)

- Anchoring materials (stakes, anchors)

- Calibration tools (flow meter, calibration equipment)

Safety Considerations

- Ensure Stability: Ensure that the excavation and backfilling processes do not compromise the stability of the canal banks.

By adhering to these steps, one can effectively install a Parshall flume in an unlined canal section, ensuring accurate flow measurement and long-term durability.